be studied further and that existing aircraft radars be modified to provide digital data so that these compaction techniques can be tested.

Data management for SEASAT–A imaging radar provided an example of a possible end-to-end data system for a future spacecraft imaging radar. This example indicated that—

1. A radar image is similar to the photographic products from other spacecraft such as ERTS, Mariner, and Pioneer.

2. The user products and the radar parameters enter the processing at several different points in the system (i.e., the ends of an end-to-end system are not singular points).

3. Two basic data products must be considered: computer digital tapes and analog photographs.

4. Ground processing must be flexible and adaptive.

5. A library for radar data is needed.

Automatic computer-processing and pattern-recognition techniques must be implemented near the user end of an end-to-end data system. The applications of these processes to imaging radar data will expand, based on previous work with multispectral data.

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PART D

PROGRAM PLANNING

This section presents a discussion and recommendations for future activities necessary to support satellite microwave sensing. The need exists for a program that will provide information in the following areas:

1. Experimental test program to establish the interaction of electromagnetic waves and sensed parameters.
2. Component development.
3. Data processing.
4. Calibration.
5. Design and fabrication of a multifrequency system.

Each area will be discussed in greater detail in the following paragraphs.

Inputs to this section were obtained from joint discussions between the TSG and the three panels of the Active Microwave Workshop.

EXPERIMENTAL TEST PROGRAMS

A requirement exists to determine experimentally the characteristics of surface features when these features are sensed by electromagnetic waves in the microwave portion of the spectrum. The stated desires and requirements of the Earth/land panel for experimental data from controlled tests were adequate to keep several aircraft systems busy on a continuous basis.

Earth/Land

The Earth/land panel has suggested an aircraft research program the objective of which would be to provide the information that has been lacking or fragmentary in this important field of remote sensing. Two additional items are highlighted for future effort: small-scale surface-texture measurements and polarization signatures.

Small-scale surface texture.—The unique capability of active microwave systems to detect variations in surface texture of geologic materials is potentially one of the most useful applications of microwave remote sensing.

A recent example of the type of detailed feasibility study necessary for a thorough examination of SLAR surface texture analysis is included in the section entitled "Com-

bined RAR and SAR Imaging." This investigation, using radar images of Death Valley, clearly indicates the importance of multifrequency radar systems to delineate small-scale surface texture, and, thus, distinct lithologies.

Sufficient SLAR images are not yet available at diverse wavelengths, polarizations, and look directions over any particular study area for a comprehensive evaluation of optimum system design for surface-texture analysis.

As part of the NASA aircraft programs plan, it is proposed that an optimum SLAR system be designed for surface lithologic identification. The system would have the following characteristics:

1. A wide spread in wavelengths (i.e., 3 cm, 25 cm, 10 m).
2. Dual polarization (HH and cross) for at least the 3- and 25-cm wavelengths.
3. Incident-angle capability from 0° to 70° (0° to 45° nominal use).
4. Maximum attainable power.

The system would have surface-texture sensitivity ranging from 0.2 to 1.8 cm and should provide geoscience users with much greater success in mapping lithologic materials than previously encountered. The NASA Jet Propulsion Laboratory X-, L-, and P-band systems and the ERIM X- and L-band systems would have immediate application to this area of investigation.

Polarization signatures.—A unique polarization technique has been demonstrated by Martin (ref. 5–39) that appears almost unknown in the microwave-sensing community. The technique is the ability to change polarization at the PRF rate (e.g., 5000 times/sec). Thus, polarization changes can be obtained in small steps (e.g., 11.25° increments). This system can obtain polarization signatures (figs. 5–108 and 5–109) on a single pass over small areas.

Use of existing data and systems.—The initiation of several interim steps is proposed to reduce the time required to provide at least part of the needed experimental information.

The first approach recommended is to begin analysis of existing imagery. Considerable radar-image coverage of the United States exists at several locations. This imagery has had only limited analysis for resource applications. Several application areas could benefit from a well-planned pro-

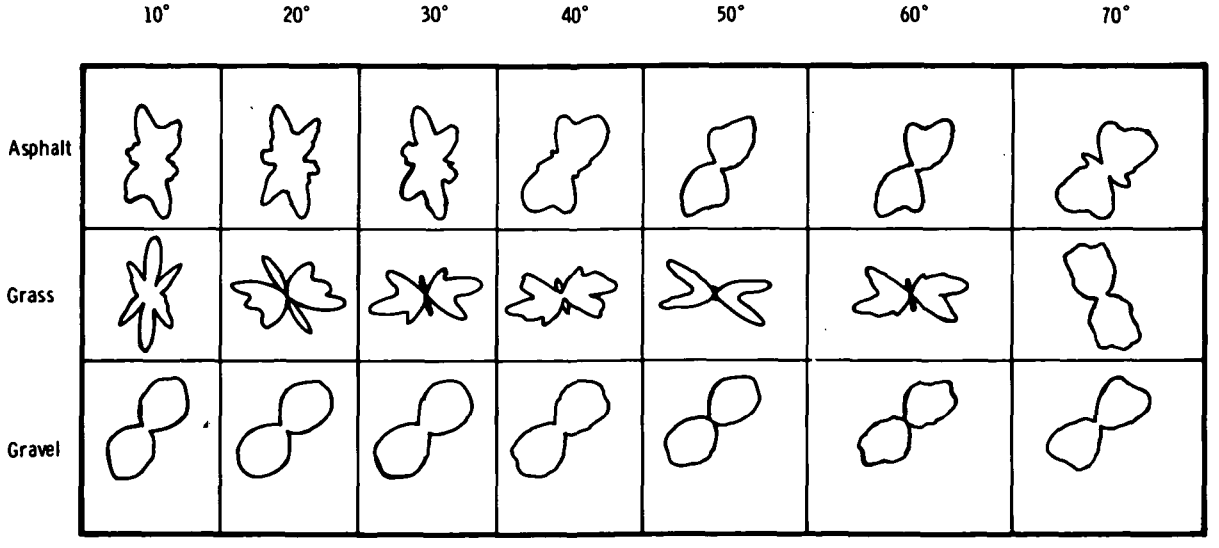

FIGURE 5–108.—Direct polarization profiles for asphalt, grass, and gravel at 8.505 GHz for various incident angles.